# IDATION OF METALS—Volume 17, 1982

rnal which provides a single forum for scientific contributions dealing with all aspects of gas-solid reactions. It includes of experimental and theoretical work; review papers will be published occasionally.

77.

### D. L. Douglass

Materials Department University of California at Los Angeles Los Angeles, California

#### ciate Editors

J. B. Wagner, Jr. Center for Solid State Science Arizona State University Tempe, Arizona

national Advisory Board J. Bénard Université de Paris Paris, France

C. E. Birchenall University of Delaware Newark, Delaware

J. V. Cathcart Oak Ridge National Laboratory Oak Ridge, Tennessee

M. J. Graham National Research Council of Canada Ottawa, Ontario, Canada

D. R. Holmes Central Electricity Research Laboratories

Leatherhead, Surrey, England P. Kofstad University of Oslo, Oslo, Norway

S. Mrowec Institute of Materials Science School of Mining and Metallurgy Krakow, Poland

K. Nishida Hokkaido University Sapporo, Japan

F. S. Pettit Pratt & Whitney Aircraft Middletown, Connecticut G. C. Wood

Corrosion and Protection Centre University of Manchester Institute of Science and Technology Manchester, England

A. Rahmel DECHEMA Frankfurt am Main, West Germany

R. A. Rapp Ohio State University Columbus, Ohio

J. Sheasby University of Western Ontario London, Ontario, Canada

W. W. Smeltzer McMaster University Hamilton, Ontario, Canada

J. Stringer Electric Power Research Institute Palo Alto, California

D. P. Whittle University of California Berkeley, California

W. L. Worrell University of Pennsylvania Philadelphia, Pennsylvania

G. J. Yurek

Massachusetts Institute of Technology Cambridge, Massachusetts

ned bimonthly at Winterstoke Road, Bristol BS3 2NT, England, by Plenum Publishing Corporation, 233 Spring Street, ork, N.Y. 10013. In 1982, Volumes 17 and 18 (6 issues each) will be published. Subscription orders should be addressed publisher. Oxidation of Metals is abstracted or indexed in Chemical Abstracts, Chemical Titles, Corrosion Abstracts, nt Contents, Energy Research Abstracts, Engineering Index, Metals Abstracts Index, Referativnyi Zhurnal, Science Citation and Solid State Abstracts Journal. © 1982 Plenum Publishing Corporation. Oxidation of Metals participates in the m of Copyright Clearance Center, Inc. The appearance of a code line at the bottom of the first page of an article in this l indicates the copyright owners consent that copies of the article may be made for personal or internal use. However, nsent is given on the condition that the copier pay the stated per-copy fee through the Copyright Clearance Center, Inc. copying not explicitly permitted by Sections 107 or 108 of the U.S. Copyright Law. It does not extend to other kinds of g, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or tle, nor to the reprinting of figures, tables, and text excerpts.

iption rates:

es 17 and 18, 1982. (6 issues each) \$160.00 per volume (outside the U.S., \$179.00 per volume). ond-class postage paid at Jamaica, N.Y.11431.

ster: Send address changes to Oxidation of Metals, Plenum Publishing Corporation, 233 Spring Street, New York, N.Y. Air Freight and mailing in the USA by Publications Expediting, Inc., 200 Meacham Avenue, Elmont, N.Y. 11003.,

i in Great Britain.

Oxidation of Metals is published bimonthly at Winterstoke Road, Bristol BS3 2NT, England, by Plenum Publishing Corporation, 233 Spring Street, New York, N.Y. 10013. In 1982, Volumes 17 and 18 (6 issues each) will be be published. Subscription orders should be addressed to the publisher. Oxidation of Metals is abstracted or indexed in Chemical Abstracts, Chemical Titles, Corrosion Abstracts, Current Contents, Energy Research Abstracts, Engineering Index, Metals Abstracts Index, Referativnyi Zhurnal, Science Citation Index, and Solid State Abstracts Journal. © 1982 Plenum Publishing Corporation. Oxidation of Metals participates in the program of Copyright Clearance Center, Inc. The appearance of a code line at the bottom of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use. However, this consent is given on the condition that the copier pay the stated per-copy fee through the Copyright Clearance Center, Inc. for all copying not explicitly permitted by Sections 107 or 108 of the U.S. Copyright Law. It does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale, nor to the reprinting of figures, tables, and text excerpts.

CONTENTS	
Sulfidation–Oxidation of Advanced Metallic Materials in Simulated Low-Btu Coal-Gasifier Environments T. C. Tiearney, Jr. and K. Natesan	1
An Evaluation Study of Aluminide and Chromoaluminide Coatings on IN-100 R. Sivakumar	27
High-Temperature Oxidation of Titanium Silicide Coatings on Titanium A. Abba, A. Galerie, and M. Caillet	43
Kinetics and Mechanisms of the Oxidation of Cobalt at 600-800°C H. S. Hsu and G. J. Yurek	55
Sulfidation of Iron at High Temperatures and Diffusion Kinetics in Ferrous Sulfide  M. Danielewski, S. Mrowec, and A. Stokkosa	77
The Effect of Supersaturation on the Parabolic Rate Constant for Internal Oxidation with Production of a Pure Oxide: An Approximate Analytical Treatment F. Gesmundo, F. Viani, and V. Doví	99
Reoxidation of Chromium with Densified Cr <sub>2</sub> O <sub>3</sub> Scales K. P. Lillerud and P. Kofstad	127
Reflectance Spectroscopy of Oxide Films. I. A Theoretical Study  Geoffrey A. Swallow and Geoffrey C. Allen	141
Reflectance Spectroscopy of Oxide Films. II. Oxide Layers on Chromium Metal  Geoffrey C. Allen and Geoffrey A. Swallow	157

## CONTENTS

CONTENTED	
Chromium Transport Through Cr <sub>2</sub> O <sub>3</sub> Scales. I. On Lattice Diffusion of Chromium  P. Kofstad and K. P. Lillerud	177
Chromium Transport Through Cr <sub>2</sub> O <sub>3</sub> Scales. II. Changes in Scale Morphology During High Vacuum Treatment of Oxidized Chromium Specimens K. P. Lillerud and P. Kofstad	195
Long-Term High-Velocity Oxidation and Hot Corrosion Testing of Several NiCrAl and FeCrAl Base Oxide Dispersion Strengthened Alloys Carl E. Lowell, Daniel L. Deadmore, and Daniel Whittenberger	205
X-Ray Topographic Study of $\beta$ -NiAl Upon Growth of an $\alpha$ -Al <sub>2</sub> O <sub>3</sub> Film T. Homma, H. M. Hindam, Y. Pyun, and W. W. Smeltzer	223
Corrosion of Iron-, Nickel-, and Cobalt-Base Alloys in Atmospheres Containing Carbon and Oxygen G. H. Meier, W. C. Coons, and R. A. Perkins	235
Editor's Note	263
Kinetics and Mechanism of High-Temperature Oxidation of Dilute Cobalt-Chromium Alloys K. Przybylski and D. Szwagierczak	267
Announcement	297

# CONTENTS

Sulfidation Properties of Fe-Cr Alloys at 1073 K in H <sub>2</sub> S-H <sub>2</sub> Atmospheres of Sulfur Pressures 10 <sup>-2</sup> and 10 <sup>-5</sup> Pa  T. Narita, W. W. Smeltzer, and K. Nishida	299
Protection of Fe-Cr-Al Alloys in Sulfidizing Environments by Means of an α-Al <sub>2</sub> O <sub>3</sub> Scale P. A. Mari, J. M. Chaix, and J. P. Larpin	315
The Kinetics of Duplex Scale Formation on 18/8 Type Stainless Steel  A. F. Smith, M. O. Tucker, and R. Hales	329
Thickness Measurements of Spinel and Chromia Layers in Stainless Steel Oxide Scales by X-Ray Diffractometry P. A. Tempest and R. K. Wild	345
Oxidation of Ti-1Si and Ti-5Si Alloys  Casimir J. Rosa	359
Morphology of Corrosion Products Formed on Cobalt and Nickel in Argon-Oxygen-Chlorine Mixtures at 1000 K M. J. McNallan, W. W. Liang, J M. Oh, and C. T. Kang	371
An Investigation of Pack-Aluminide Coating on Steel R. Sivakumar and E. Janardhana Rao	391
Application of X-Ray Energy Dispersive Analyses (EDAX) to Determine the Penetration Depth of One Oxide Phase (NiAl <sub>2</sub> O <sub>4</sub> ) in a Two-Phase Oxide Internal Oxidation Zone (NiAl <sub>2</sub> O <sub>4</sub> + Al <sub>2</sub> O <sub>3</sub> ) of a Binary Alloy (Ni-Al)  F. A. Elrefaie and W. W. Smeltzer	407
Oxidation of Titanium Modified Type 310 Stainless Steel in Low Oxygen Partial Pressure Atmospheres A. S. Nagelberg	415
<sup>18</sup> O Tracer Studies of Al <sub>2</sub> O <sub>3</sub> Scale Formation on NiCrAl Alloys K. P. R. Reddy, J. L. Smialek, and A. R. Cooper	429
Author Index to Volume 17 Subject Index to Volume 17	451 453

